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REPORT ON GERMAN MULTI-PLEX INTERCEPT EQUIPMENT

by Lt. HOLMES, A.U.S.

(See also TICOM/M-6, M-7, M-8)

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REPORT ON GERMAN MULTI-PLEX INTERCEPT EQUIPMENT

LT. HOLMES, A.U.S.

1. GENERAL

1.01 It is the purpose of this report to describe German equipment designed to intercept multiplex transmissions. The oldest of the three types of equipment available was employed in the interception of a six channel multiplex. This item was designed by Siemens-Halske and is designated WA PRUF 7/IV. The next machine is a two channel multiplex intercept set designated "GERÄT 1313" and "HZFS". The final machine is a universal intercept set and can receive normal radioteletype, or 2, 3, 4, 6, or 9 channel multiplex. It is designated "GERÄT 1309" and "HMFS".

2. DESCRIPTION OF THE SIX CHANNEL SET.

2.01 The six channel set consists of a distributor unit, six teleprinters and a power rectifier. The distributor unit is 10" X 21" X 36" and has a front panel face as shown in Fig. 1. The signal is fed into the distributor which regenerates each channel, together with the proper mark/space impulses, and feeds the resultant signal to the proper teletype machine.

2.02 Commutation is accomplished by means of cams. Thirty-two cams on a single shaft are driven by a synchronous motor coupled to a d.c. motor which assumes the major part of the load. Each of the thirty-two cams operates its switch during one of the thirty-two bauds of the signal, providing the cam shaft is rotating in synchronism with the signal. Thirty of the cams control the selection of the characters in the six teletypewriters. There are five cams per teletypewriter.

2.03 The rigid speed requirements on an equipment of this type are met by the synchronous motor, d.c. motor combination. The d.c. motor assumes the major part of the load necessary to bring the shaft to the correct speed. The synchronous motor which is fed from a tuning-fork controlled oscillator actually locks the shaft to a constant speed which can be altered by proper control but which will be constant at any given setting of those controls.

2.04 A visual indication of the relation of the signal to the cam shaft is provided by a ring of thirty-two neon lamps on the front face of the machine. When the cam shaft is in synchronism with the signal the first of two adjacent lamps which are clearly marked will light on every cycle and the other of the two lamps will light only occasionally.

2.05 When synchronism has been initially achieved visually, automatic synchronism can be accomplished by throwing a key. Automatic synchronism is accomplished by means of the final two cams not used to control the selection of characters.

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3.

REPORT ON GERMAN MULTI-PLEX INTERCEPT EQUIPMENT (Cont'd.)

3. FEATURES OF THE SIX CHANNEL SET.

3.01 The oscillator which drives the synchronous motor is a tuning-fork controlled oscillator. The tuning-fork frequency is controllable from the front panel by means of a plunger which moves weights on either arm of the fork. This results in a controllable frequency over a limited range which is highly stable.

3.02 As mentioned before automatic synchronism is accomplished by use of two of the thirty-two cams on the shaft. These cams will be designated "A" and "B". If the cam shaft is in synchronism with the signal, cam "A" will close its switch at the correct time to pass the "mark" baud of the synchronizing section of the signal, and cam "B" will close to pass the "space" baud of the synchronizing signal. The correct adjustment of the oscillator is a small bit slower than the signal, in which case the "mark" baud of the signal will tend to arrive later and later with respect to the cam shaft speed. Thus cam "B" will close to pass the "mark" baud that "A" was previously passing. When "B" closes on "mark" a correcting action takes place to advance the cam shaft and bring the "mark" back under the control of "A".

3.03 The correcting action taken to advance the cam shaft is of interest: The synchronous motor housing is mounted in bearings and is coupled by means of gears and a normally disengaged clutch to the d.c. motor drive. When "B" closes on a "mark" baud the clutch is engaged and the entire synchronous motor housing is rotated slowly until "B" no longer closes on "mark". This system is advantageous in that its range of control is considerable in one direction, but it can exert no control in the other. Therefore, the motor must be set normally slow and the setting is at the discretion of the operator. If it is set too slow very short fades will force the machine out of synchronism. If it is set at all fast it will not lock.

3.04 The use of cams instead of distributor disks and brushes is of interest and is in fact a desirable feature from the aspects of maintenance.

4. DESCRIPTION OF THE TWO CHANNEL SET.

4.01 The two channel set consists of a distributor unit and two teletypewriters. The distributor unit is 19 $\frac{1}{2}$ " X 32" X 43" and has a front panel face as shown in Fig. 2. The signal is fed into the distributor unit which regenerates each channel and feeds the resultant signal plus operating pulses to the proper teletype machine.

4.02 Commutation is accomplished by a double distributor on a single shaft. The shaft is driven by a synchronous motor and a d.c. motor in a single housing. The commutated signal is stored in banks of relays and the printing is accomplished from these relays.

4.03 The synchronous motor, d.c. motor combination functions in this set as described in para. 2.03, with the exception that the oscillator feeding the synchronous motor is not tuning-fork controlled.

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REPORT ON GERMAN MULTI-PLEX INTERCEPT EQUIPMENT (Cont'd.)

4.04 A visual indication of the relation of the signal to the drive shaft is provided by an oscilloscope having a circular trace. The circular trace is generated by a rotating magnetic yoke around the tube which is coupled to the drive shaft by gears. The signal is applied as additive deflections to the magnetic coils on the yoke. Also applied as an additive deflection is the output of a short segment on the first of the two distributors. This forms a stationary pip on the scope which acts as a marker for properly phasing the distributor to the signal.

4.05 When synchronism has been initially achieved visually, automatic synchronism circuits assume control and maintain synchronism. Automatic synchronism is accomplished in this set by means of three consecutive short segments on the first of the two distributors. Synchronism is correct when the "mark" baud of the signal arrives as the brush sweeps the first two segments and when the "space" baud of the signal arrives as the brush sweeps the last segment. If the signal arrives early all three brushes are "mark" actuated, and a correcting action occurs to speed up the motor by increasing the oscillator frequency. If the signal arrives late only the first of the three brushes is "mark" actuated and a correcting action occurs to slow down the motor by decreasing the oscillator frequency.

4.06 The operation of this set is described completely in the German manual furnished with the equipment. This manual is available.

5. FEATURES OF THE TWO CHANNEL SET

5.01 The oscilloscope method of achieving visual synchronism is very good. Particularly the application of the magnetically deflected circular trace is worthy of note.

5.02 The concept of storing impulses in relays as applied to multiplex intercept is unusual. In this particular equipment five relays in each "Speicher" are set up with the intelligence of the multiplex cycle being received. Then the printing is accomplished from these relays. Finally just before the next cycle must be stored all five relays are cleared.

5.03 Provision is made to insure that the synchronous motor is locked to the oscillator frequency. This is accomplished by putting the synchronous motor current through the oscilloscope deflection coils. When the motor is locked in, the pattern on the scope is a toroid. When the motor is not locked in the pattern becomes petalled as a result of beating.

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REPORT ON GERMAN MULTI-PLEX INTERCEPT EQUIPMENT (Cont'd.)6. DESCRIPTION OF THE UNIVERSAL SET

6.01 The universal set consists of a distributor unit and nine teletypewriters. The distributor unit is 19½" X 72" X 43" and has a front panel face as shown in Fig. 3. The signal is fed into the distributor unit which regenerates each channel and feeds the resultant signal plus operating pulses to the proper teletype machine.

6.02 Commutation is accomplished by a double distributor on a single shaft similarly to the manner used in the two channel machine. This universal machine, however, is designed to permit interchanging of distributors. The machine is also provided with a set of distributors, each of which is made to commutate one of the multiplex transmissions for which the machine was designed. Thus by inserting the proper distributor in the machine any one of several types of transmissions can be intercepted.

6.03 In all other respects the universal machine functions like the two channel machine.

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6.

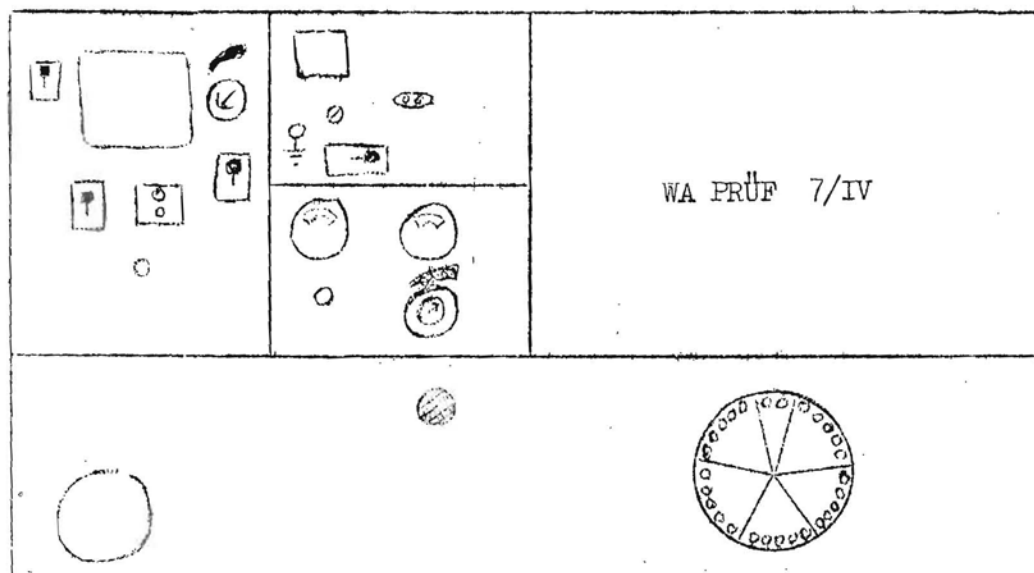


FIGURE ONE

60 v Stage	Valve Rectifier II	Valve Rectifier I	12 volt Stage	
Drawer	MECHANICAL PART		Drawer	
Drawer			Drawer	
Receiving Amplifier	Speicher No. 1	Control Panel	Speicher No. 2	Sync Amplifier

FIGURE TWO

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S P E I C H E R S									
No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	Spare
Drawer		MECHANICAL						Drawer	
Drawer		PART						Drawer	
Receiving Amplifier		CONTROL PANEL						Sync Amplifier	
Valve Rectifier I								Valve Rectifier II	
Auto Transformer I		12 v stage			60 v stage			Auto Transformer II	

FIGURE THREE